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THE USE OF BLOCK DIAGRAMS IN PRESENTING CRIME STATISTICS: CASE STUDY, EDMONTON

by

© Ernest Stinner

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF GEOGRAPHY

EDMONTON, ALBERTA

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE USE OF BLOCK DIAGRAMS IN PRESENTING CRIME STATISTICS: CASE STUDY, EDMONTON

submitted by Ernest Stinner

in partial fulfilment of the requirements for the degree of Master of Science

ABSTRACT

This thesis attempts to show the utility of the three-dimensional block diagram as an aid in presenting statistics. The data, in this work, are all the crimes know to the Edmonton City Police Department for 1968.

This work is divided into five section:

1. Chapter I consists of the purpose and objectives of this paper.
2. Chapter II gives a brief introduction of Thematic Cartography.
3. Chapter III states the theme to be mapped and explains the method of data collection and tabulation.
4. Capter IV, the major section, explains and describes the mapping technique of the various diagrams used to present the theme.
5. Chapter V is a critical evaluation of the techniques used in Chapter IV.

ACKNOWLEDGMENT

I should like to express my sincere gratitude to the following people: Marilyn Bekolay for the typing, Inspector Stevens and Deputy Attorney General S. Friedman for making the data available, Dr. D. B. Johnson for his help in organization, Dr. T. Hartnagel for his suggestions, Mr. W. McVey for his editorial help, Dr. L. A. Kosinski for his valuable suggestion on the text, and Prof. J. J. Klawe who is responsible for my cartographic training: thank you. And a very special thanks to my wife Beatrix, whose constant encouragement was always appreciated.

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CHAPTER I

THE PURPOSE OF THIS STUDY

It is the objective of this paper to demonstrate, discuss and evaluate the cartographic technique of the two-point perspective block diagram as a means of portraying social statistics in thematic mapping.

A block diagram is simply a "...'block' cut out of the earth's crust and tilted upwards and sideways so that two sides as well as the top become visible".[1] Until very recently block diagrams were used mainly by geologists and geomorphologists in portraying a "block" of land in relief to facilitate a greater ease of study.

> "They (block diagrams) have the advantage that geological sections can be appended to the sides of the block thus enabling correlation to be made between structure and surface."[2]

In a statistical block diagram, we are not concerned with the shape of the land's surface but rather its area and the surface features, which we will construct artificially, in relation to the statistics we attribute to this area.

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1. Robinson, Arthur H., Elements of Cartography. John Wiley and Sons, Inc. 1960.

2. Monkhouse, Francis J. and Henry R. Wilkinson, Maps and Diagrams, Methuen, London, 1964.

Because of the great use of aircraft as a means of transportation, most people are familiar with an oblique view of the earth's surface. "The natural appearance of the surface forms on a perspective block makes the concepts easily understandable to anyone."[1]

> "...many readers are unable to comprehend the complex undulating topographic and statistical surfaces shown on normal planimetric maps. Well constructed 3-D maps, on the other hand, seem to be comprehensible to the uninitiated map-reader, and thus are judged by these authors to be a more suitable means of communication. There are also those who contend that every map-reader, regardless of experience, can benefit from 3-D representations because they facilitate a more complete understanding of surface detail."[2]

The study area selected for this work is Edmonton. It is located approximately in the centre of the province of Alberta. (53° 30' Latitude North by 113° 30' Longitude West) and is the eighth largest urban area in Canada. In less than a century it has attained its population of 438,155 (Statistics Canada, June 1971). Any major city could have been chosen; however, since the author resided in Edmonton, its statistics were most easily attainable.

The data for this study consist of crimes known to the police for the city of Edmonton, 1968. Crime data were chosen for the following reasons. There are few if any crime maps available

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1. Robinson, Arthur H., Elements of Cartography. John Wiley and Sons, Inc. 1960.

2. Jenks, George F., and Paul V. Crawford, Viewing Points for Three-Dimensional Maps, Techincal Report No. 3, University of Kansas, Lawrence, Kansas. September 1967.

for Edmonton; this is the case in most cities. Crime affects most of us directly or indirectly, and is therefore of great concern to everyone.

A Short Review of the History of Crime Mapping

In the early nineteenth century, countries such as Sweden, Great Britain and the United States started government census. (Fr. Canada in 1665 was the earliest.) This precipitated for the first time, readily available social and economic statistics. Cartographers soon recognized the need of presenting this data so as to show areal distribution in relation to the statistics. Statistics concerned with crime were known as "Moral Statistics" and Adolphe Quetelet (1796 - 1875) was one of the pioneers in the mapping of crime; the maps illustrating his essay, "Sur L'homme et le Development de ses Facultes, 1830" show the distribution of violent crimes in France and the Low Countries. His method was that of shading - the greater the number the deeper or darker the shade. A. M. Guerry's "Statistique Morale de l'Angleterre comparee avec celle de la France, 1830" used more sophisticated graphic methods in his crime maps. He not only used shading but was the first to use histograms.

Most crime maps, since their advent to the present day, use two major graphic techniques; graphs and shading. Under graphs we find the histogram, the bar graph, and various circle graphs, whereas with shading the choropleth seems to have become the most popular. In the last decade the block diagram is beginning to create interest as a technique with great potential to present statistics. (See L. A. Kosinki's - Exhibits of Early Distribution Maps in the British Museum.)[1]

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1. Kosinski, L. A., Geographical Review, Vol. 60, No. 2, 1970. pp. 267-269. The American Geographical Society of New York.

The term, "geography of crime," is a relatively new one among geographers. The following four men are perhaps the best known in this aspect of geogrpahy; they are, K. D. Harris, P. D. Phillips, Y. Lee and F. T. Egan.

Harris in his articles, "Social Indicators and Metropolitan Variation in Crime" and 'The Geography of American Crime, 1968," uses a prescribed set of variables to study inter urban crime indicators. He reveals the importance of such variables as, a youthful population, a minority factor and the size of the metropolis as indicaters of crime rates. In "The Geography of American Crime" he simply plots major crimes of personal assault and crimes against property. His findings that the south east was very high in murder and that the southwest was high in rape surprised him. Both articles contained maps the former a dot map and the latter a computer printed choropleth map using the 48 states as his deliniations.

P. D. Phillips' article "A Prologue to the Geography of Crime," is a resume of the work of European criminologists in the last century. Yuk Lee and Frank Egan use Denver as their study area in their article "The Geography of Urban Crime." They use the distance from CBD, crowding and areal size as their main variables.

None of these geographers make use of any but the simplest mapping techniques to show their findings, however, since this is a new subject for them their energies are no doubt taken up with their findings and not with the techniques of presenting them.

See: Harris, Keith D., Lee Y., and Phillips, P. D. in bibliography.

A Short Review of the use of the Block Diagram

According to F. J. Monkhouse,[1] block diagrams were probably first used to any extent by G. K. Gilbert (U. S. Geographical and Geological Survey of the Rocky Mountain Region, Washington, 1877). The early block diagrams were simple sketch diagrams drawn by eye of a landform. Later sketch block diagrams were drawn from contour maps, not necessarily in perspective but giving an oblique view. This oblique block was gradually developed into the block diagram which was accurately transposed from a contour map and drawn to a two-point or true perspective. Other than showing geological sections, block diagrams were also used for detailed regional study of small areas, such as mountains, valleys and islands.

Probably the man most responsible for today's increased use of the three-dimensional block diagram is G. F. Jenks of the University of Kansas. Jenks advocates the use of statistics in both a stepped manner and in a smooth continuum to get vertical development on the two-point block diagram.

With the invention of drafting machines, cathode-ray tubes and line plotters which can be hooked directly to a programmed computer, the three-dimensional block diagram is becoming more popular.

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1. Monkhouse, Francis J. and Henry R. Wilkinson, Maps and Diagrams, Methuen, London, 1964.

SYMAP, a computer program for drawing three-dimensional maps, was developed at Harvard University in the last decade. Recently the United States Atomic Energy Commission, at Los Alamos has demonstrated the amazing versatility of the computer where three-dimensional graphs or diagrams are produced in seven different colors to show complex mathematical relationships. (See Fantastic Computer Pictures, Popular Science, Feb. 1973.)[1]

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[1] Prueit, Melvin L., Fantastic Computer Pictures Give Us a New Look at Numbers. In: Popular Science, New York, Feb. 1973.

CHAPTER II

THEMATIC CARTOGRAPHY

The topographic map has for many years been acknowledged as the most indispensable tool in the understanding of the complex relationships of areal distribution phenomena. Thematic maps have just recently come to the fore to help show the complexities of the results of human interaction. For hundreds of years cartographers, mainly in Europe, have worked on the improvement of topographical mapping both as a science and as a technique to keep up with new land discoveries. The situation in thematic mapping is the reverse. Statistices on human functions suddenly appeared in such great volume that the need for thematic maps became immediately imperative. The science and techniques to handle this great diversity of statistics had to spring up overnight and did not have the advantages of years of preparation as did the topographic maps. We are at the point today where thematic maps have not only caught up but have surpassed topographic maps in quantity if not in importance.

The flood of thematic maps and atlases has reached such proportions that it is impossible to comprehend them all. Because of this mass of maps, there has not been sufficient time to construct a methodology leading to a reasonable standardization of quality. This, of course, has both advantages and disadvantages. Many of these new maps are constructed by people who do not fully understand the impact of some cartographic methods and thereby communicate erroneous

impressions. On the other hand many talented individuals have come up with some very exciting and novel techniques which greatly enhance this aspect of mapping.

The Character of Thematic Maps

The basic idea or function of a topographic map is to convey as accurately as possible the relative location of features on the earth's surface, in short, that of orientation. The basic idea or function of a thematic map on the other hand is to give information on a particular theme, in relation to areal phenomena. The thematic map shows simultaneously not only the visible features of the earth's surface as does the topographic map, but also consciously brings out one definite theme at the same time, such as climate, population density or traffic rate and so on. The thematic map seeks to portray abstract ideas, trends and pertinent questions. It draws from all aspects of an area, especially those elements that are a direct consequence of man: his impact, interdependence and relationships to one another with reference to spatial differentiation. The thematic cartographer should not only restrict himself to mapping phenomena for a static point in time. His maps could also be dynamic if he wishes to keep up with today's rapid changes. He is to portray the "zeitgeist"[1] of whatever theme he has chosen. Ideally such a method is most purposeful if it can be used to predict future trends.

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1. zeitgeist - German, spirit of the times.

In short, the basic character of thematic maps is the study of variables according to their position, appearance, extent and uniqueness in relationship with other phenomena in a designated area.

Relationship to Topographic Maps

A topographic map is the prerequisite or basis of all thematic maps. The making of a thematic map depends on the use of a more or less simplified topographic base map. Usually the simplification or generalization of the topographic features of the base map is such that drainage, political boundaries or roads are the only topographic features that remain. These topographical features serve merely as a background for orientation, in relation to the main facts of the map, which, or course, is the selected theme.

A clear-cut separation of the topographic and the thematic is not possible since even topographic maps have some thematic symbolization and, as mentioned above, thematic maps have some orientational aspects.

Types of Thematic Maps

Scale is the most limiting factor in the classification of maps because the smaller the scale the more one has to generalize and the more one generalizes the less accurate the information on the map becomes. Maps are usually classified according to the following three scales:

a. up to 1:50,000

b. 1:50,000 to 1:200,000

c. 1:200,000 to 1:1 million and up.

These are known as specialized, large scale and small scale, respectively (See Inhof, Eduard).[1]

This is not to imply, however, that only scale determines the map. Unlike topographic maps, thematic maps are largely determined by their theme which, after all, is the raison d'etre of the map. A theme on a map is justified only when the information is related in some way to the area which it represents (i.e. distribution, density, extent). If this aspect of relationship between the theme and the area is not present the map is worthless.

As mentioned before, a good cartographer should be working on techniques to show both the static and dynamic aspects of phenomena. In essence a map lends itself naturally to illustrate a particular condition in a certain place at a precise moment in time. However indicating movement over a period of time becomes very difficult and taxes the ingenuity of the cartographer. Trends are usually shown by several static maps or by a complex static map, that is, by a map showing two or more static features. The only true dynamic map is seen in a film where a series of frames are used and the statistics are animated to show true movement since all aspects of human life, whether political, social, economic or cultural, are bound to the earth's surface. If given enough information one can map anything.

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1. Imhof, Eduard, Kartographische Gelendedarstillung W. De Gruytes and Co., Berlin, 1965.

The Need for Thematic Maps Today

The cliche about one picture worth a thousand words is especially true today. Information reaches us through our senses, the most impressionable one being vision. For example: a tourist in a strange city asks a man to direct him to a certain location. This information could be conveyed by one of two means: (a) explicit verbal instructions, or (b) a simple sketch map. It is obvious which of the two methods of information given is simpler and more comprehensible. The sketch map can portray needed infornmation in the most concise way.

Because of the various media of communication today, one can be totally overwhelmed with facts and views, to the point where they tend to confuse and discourage by their sheer volume. Since modern technology has shrunk the earth, making information available from the remotest part of the globe, modern man has a need for this information simply because it exists. Perhaps because of today's great social unrest, nations as well as individuals feel more secure the more information they possess both about themselves and one another.

From the individual census taker to the electronic traffic counter to the infra-red scanner in a satelite, information in large volume is being accumulated daily. All these facts are processed and most are published; however how many of them are used or even understood is another question. Geographers, sociologists, demographers, economists and others attempt to sort through this information to

discover some sort of pattern before more information renders their findings obsolete.

One of the greatest problems facing man is the evaluation of pertinent facts and elimination of the unimportant. Few individuals or agencies have the time or courage to read as much as is needed to keep up with the current world. Both scientist and the layman are asked to make decisions from a great quantity of statistics.

One answer to this problem is precision and generalization. Reviews, synopses, charts, graphs, films and filmstrips are all relatively new words identifying alternatives which are achieving greater importance and popularity. Ideally, thematic maps can impose some order on this amorphous mass of information.

The Advantages of Thematic Maps as a Form of Communication

No human being can construct a meaningful mental picture from a table of statistics, consisting of a few thousand bits of information. Calvin Schmid[1] summarizes, in five points, the advantages of charts and graphs over the tabular and text form of statistics. Although he refers mainly to charts and graphs, his summary holds true for all graphic techniques used in thematic maps.

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1. Schmid, Calvin F., Handbook of Graphic Presentation. The Ronald Press Co., New York. 1954.

His five points are the following:

> "1. In comparison with other types of presentation, well-designed charts are more effective in creating interest and in appealing to the attention of of the reader.
> 2. Visual relationships, as portrayed by charts and graphs, are more clearly grasped and more easily remembered.
> 3. The use of charts and graphs saves time, since the essential meaning of large masses of statistical data can be visualized at a glance.
> 4. Charts and graphs can provide a comprehensive picture of a problem that makes possible a more complete and better balanced understanding than could be derived from tabular or textual forms of presentation.
> 5. Charts and graphs can bring out hidden facts and relationships and can stimulate, as well as aid, analytical thinking and investigation."

Basically the great utility of thematic presentation over tabular statistics is:

a. large number of individual bits of information (statistics) are,
b. translated and generalized into a graphic form, which are then
c. superimposed onto a very simplified and generalized topographic map giving all the advantages of the above cited five points, as well as the important aspects of spatial relevance and orientation.

CHAPTER III

EDMONTON CRIME STATISTICS AS THE MAP THEME

The city may be man's greatest achievement; however it is rapidly becoming man's greatest problem. In fact, large cities are often synonymous with the problems of smog, slums and traffic congestion. In the United States the Bureau of Census announced back in 1960 that two thirds of its population lived in Standard Metropolitan Statistical Areas. In Canada, (1966 Census) the Dominion Bureau of Statistics noted that of its twenty million inhabitants, fifteen million (74.1%) lived in urban areas. By 1971 over 50% of Canada's population resided in the ten largest metropolitan areas (Statistics Canada).

Many problems occur where man lives, therefore it follows that our biggest problems are where the most people are, namely the cities. It also follows that the study of urban problems is one of the most important aspects of modern life, especially in North America.

Countless books, studies, charts and maps have been published concerning cities and their problems. These have mainly been about the physical environment; that is slums, housing and transportation. Studies on the population are also numerous. These cover the quantity of population such as the number of certain ethnic groups, occupations, age, sex and so on. Valuable as these factors are, they

tell relatively little about the population quality. "Most population maps show number of individuals but ignore the quality of these persons."[1]

Crime is a reoccurring phenomena that is present in every society. Crime affects everyone directly or indirectly. It is a topic that holds the interest of any group as we all seem to have a curiosity concerning mishaps and wrongdoing. The city of Edmonton spent close to six million dollars to cover loss and damage of property due to the committing and occurrences of major crime and traffic violation. This amounted to more than fifteen dollars a year for every Edmontonian.

The distribution of crime areally is known as the ecology of crime. The only satisfactory way to show areal distribution is, of course, the map. That is the purpose of the following diagrams. The reason for using crime statistics rather than some other social or economic factor is because crime maps are needed. There are no comprehensive maps of crime available in Edmonton today. Also, like many people I find the subject very interesting and worthwhile.

Method of Data Collection

One reason why there are so few maps showing crime in an area is the difficulty of obtaining information on this subject. Rarely are statistics of this type available to the public. Because

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1. Zelinsky, Wilbur. A Prologue to Population Geography. Prentice-Hall, Inc., Englewood Cliffs, N.J.

of certain legal implications involved some of this information is rather sensitive. Precautions must be taken by both the agency that provides the information and the compiler or publisher of the information so that there is no offending personal information. Lawsuits for invasion of privacy or defamation of character would be highly likely if some of the information would not be edited properly.

The data on suicides were obtained by going through the individual files for all of 1967. Only after giving assurance that I was interested in the location of the crime and not other personal information, were the files made available. Each case was located by city address and then plotted on a city map, as close to the actual location as possible. In all but one case the location was exact to within several hundred feet, the exception being a drowning in the North Saskatchewan River which is rather hard to plot, not knowing where death took place and how far the current carried the victim before recovery.

The hit and run statistics were all hit and runs reported to the police. These range from the smallest scratch in a parking lot to fatalities. As with suicides, only the location was needed. Each case was plotted according to intersection and occurrence within a block. Here again the position is not exact; however, it is well within a few hundred yards.

The Edmonton Police department gave the University the loan of an I.B.M. tape which carried all crimes known to them in 1968. This tape, containing some 58,000 bits of information, was processed through the University's computer which then made a printout according to crime

by area. Area in this case means a polling division. A polling division is a politically defined geographic area. It is set up by the city returning officer and varies in size from ten to fifteen city blocks. The approximate population is about two thousand. These polling divisions divide the city into two hundred and seventy-eight parts (1968). The police department used polling divisions because their police districts were made up of such divisions. This system is now under review and a subdivision of polling divisions into a smaller base unit system with about a two-block area is considered.

The Grouping of Offences

The police data contained ninety-seven different crimes. Most of the offences are indictable although some are only summary convictions (i.e. murder vs. drunkenness). These ninety-seven offences are grouped, by the police, into categories according to the character of the offence. For example, common assault, assault causing bodily harm and assault on a peace officer were all classified or grouped under "Assaults". The smallest grouping is that of "Possession of Stolen Goods" which includes only that offence. The largest grouping is under the liquor control act, which includes some ten different offences. Under the heading of "Thefts", there are six different offences. The entire group known as theft is coded in the printout as 104 plus two additional digits. These last two digits indicate the exact type of theft, for example, theft over fifty dollars is 10401 while purse snatching is known as 10405 and so on.

CHAPTER IV

THE THREE-DIMENSIONAL BLOCK DIAGRAM

The Two-Point Perspective Diagram
Diagram 1

The actual construction techniques of a three-dimensional diagram is contained in most cartography textbooks. (Robinson 1961, Schmidt 1954, Labeck 1958, Raisz 1948). Diagram I is an illustration of the two-point perspective block diagram. Here the 1968 Edmonton city limits were used to delimit the outline of the block. This illustration shows an original block of land drawn to perspective. Within this block the outline of the city was placed. Edmonton's outline or boundary lends itself very readily to a block diagram since most of its borders are straight and at right angles to each other with the exception of the river and the south west and north east.

The thickness of the block, in this case, is unnecessary since, as in most commonly used block diagrams, the data is not geological, but statistical. It was included, however, to give a better illustration of the three-dimensional "block".

The use of statistical data, especially the kind used in this paper, obviates going below ground level. The three-dimensional effect, or the thickness, of a statistical block diagram comes from the amount of data rising above the ground line (that is to say the

representation of the data), not below it, as in the familiar diagrams used in geomorphology and geology.

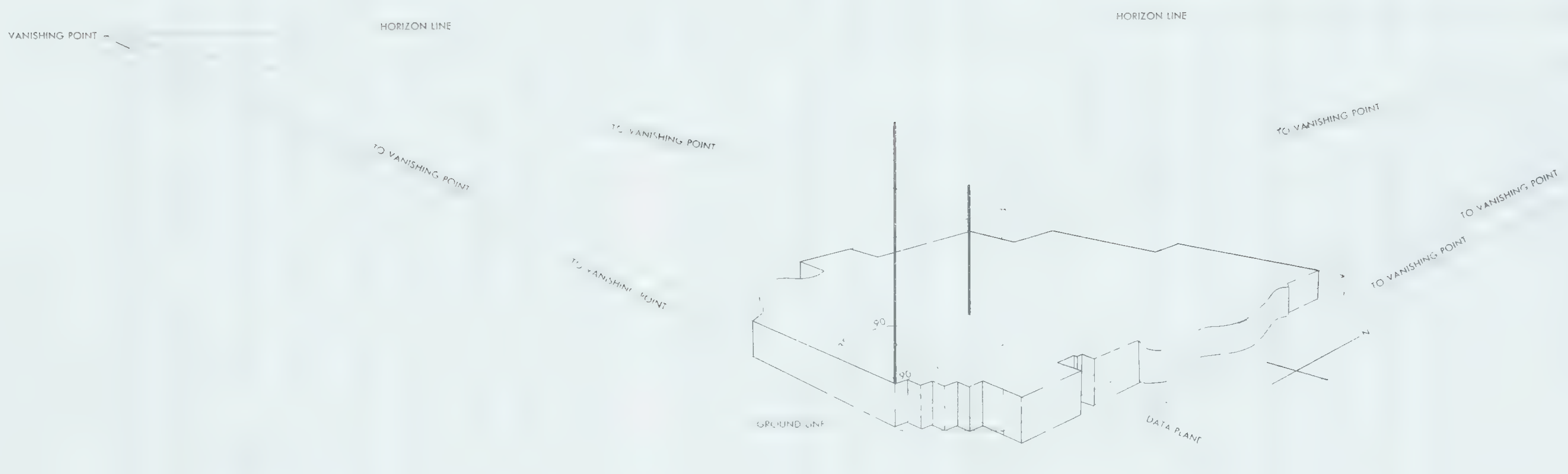
The ground line in the usual block diagram becomes the datum plane in a statistical block diagram. The datum plane is simply a flat surface or the zero value plane. From this flat surface all positive statistical values rise perpendicularly, and conversely, all negative values would then lie below. The datum plane does not necessarily have to start at a zero value but could start at the lowest value common to the entire plane. This is illustrated on several of the following diagrams. The two large vertical colums illustrate the direction of the statistics which will be piled up, so to speak.

When contructing a three-dimensional diagram the cartographer immediately runs into several basic problems for which he must find solutions before proceeding. These are the angles of tilt of the block and the directional angle of view or the azimuth.

Let us first consider the directional or viewing angle of the block, its azimuth. Before deciding on a direction, the character and location of the largest "pile" of statistics had to be noted. Several maps were drawn at various azimuths. The one deemed most suitable was 298° east of north. This places the viewing point roughly from a southeasterly position, that is to say that the observer is looking approximately towards the northwest. There were several major reasons for the selection of this azimuth. First, most people enter Edmonton from the south, whether by plane or by car. Secondly, this choice puts the direction of north somewhere near the top of the page, east on the right, west on the left and south near

the bottom. Had a map with an azimuth of 95° been chosen, the observer would have been facing south. This would have placed north near the bottom of the page and south near the top. The convention of north near the top is so ingrained that even frequent map users would be totally confused and Edmonton would seem unfamiliar.

The second major reason for the 298° view is a practical one. The southern and eastern areas of the city are relatively empty, yielding a relatively low pile up of statistics, whereas the center, the north and the west have a higher pile of data. We therefore minimize the problem of blocking or of shadowing important areas. Blocking will be discussed further in relation to diagrams 8, 9, and 11.



TWO POINT PERSPECTIVE BLOCK DIAGRAM
SHOWING BASIC CONSTRUCTION TECHNIQUE

FIGURE 1

The Isometric Block Diagram
Diagram 2

The correct choice of the tilt angle of the block from the horizontal is very important. A planimetric map has a tilt of 90° which means that the observer is figuratively hovering directly above the area. A 0° angle is a profile or a viewpoint directly facing the area on the same plane. Any angle in between gives us the illusion of a bird's eye view. This is accomplished by tilting the area or block at an angle to the horizontal.

The angle of tilt has a profound effect on the appearance of any vertical development on a flat plane which can readily be appreciated if one imagines looking at Edmonton from the Calgary Highway, then slowly ascending in a helicopter until one is at approximately 2,000 feet. The higher one goes or the greater the angle between the observer and the plane of the city the more extensive the view. This is exactly the same as tilting the block from the horizontal, only in reverse.

Three oblique isometric block diagrams are used, in diagram 2, to illustrate the relative position of two arbitrary points. The tall vertical columns are the same height on each block. Note the difference in height of the center column; it appears below the horizon of the tall column in the 40° block. As we tilt the block to 55°, the top of the center column is now almost level with the tall column. On the 65° block the center column's top is now on a higher level than the much taller corner column. The higher we tilt the block the harder it is to determine the relative heights of the center columns.

Note also the position of the two columns. They are located in the same position of each block in each case. In the 45° block the two columns are quite separate and distinct; as we tilt to 55° they seemed to have moved closer together. At 65°, the two are almost in line; if tilted further, approximately to 69° the two columns are in one line of sight. This is essentially what is called "blocking". If the smaller column were slightly shorter, or of a lesser value, it would be completely blocked and in the shadow of the taller column. Therefore, the selection of angle of tilt as well as the viewing angle are of the utmost importance to the cartographer.

On Diagram 1 the tilt angle from the horizontal is 35° and the viewing angle, as stated, is 118°. This was considered the most realistic and aesthetically pleasing as well as the best choice for the purpose. The columns in this case are in relatively good positions. Their relative height and positions appear quite realistic.

The viewing angle is optimum in that the front section of the block has relatively low statistical development. Therefore blocking of the high central area is minimized.

Diagram 2 was drawn isometrically for the express purpose of comparing it to the two-point perspective block. The main point to note in an isometric block is that all lines which are parallel on the ground will remain parallel in the block even though some of the angles may change. The fact that there is no converging makes this block mathematically more correct than the two-point perspective

but also more confusing. According to Jenks and Crawford[1] the three major aspects that make a good three-dimensional map are clarity, realism and aesthetic quality; these three are inseparable.

Realism: Since the human eye sees all far away objects smaller, and all parallel lines visually converging in the distance, the mind accepts this convergence as normal and realistic, even if this is not the case. Because of this acceptance, the two-point perspective (because it converges) is more realistic to the mind than the isometric (which does not converge) even though the isometric is more correct. We therefore view the two-point block as more realistic, familiar and easily understood than the isometric diagram.

Clarity: Since the two-point block is more familiar and realistic to use it is therefore less confusing than the isometric block and hence objects on its surface will appear clearer and more understandable.

Aesthetic quality: It seems logical that if the "best" three-dimensional diagram is the one that is clearest and most realistic it should also be the most aesthetic.

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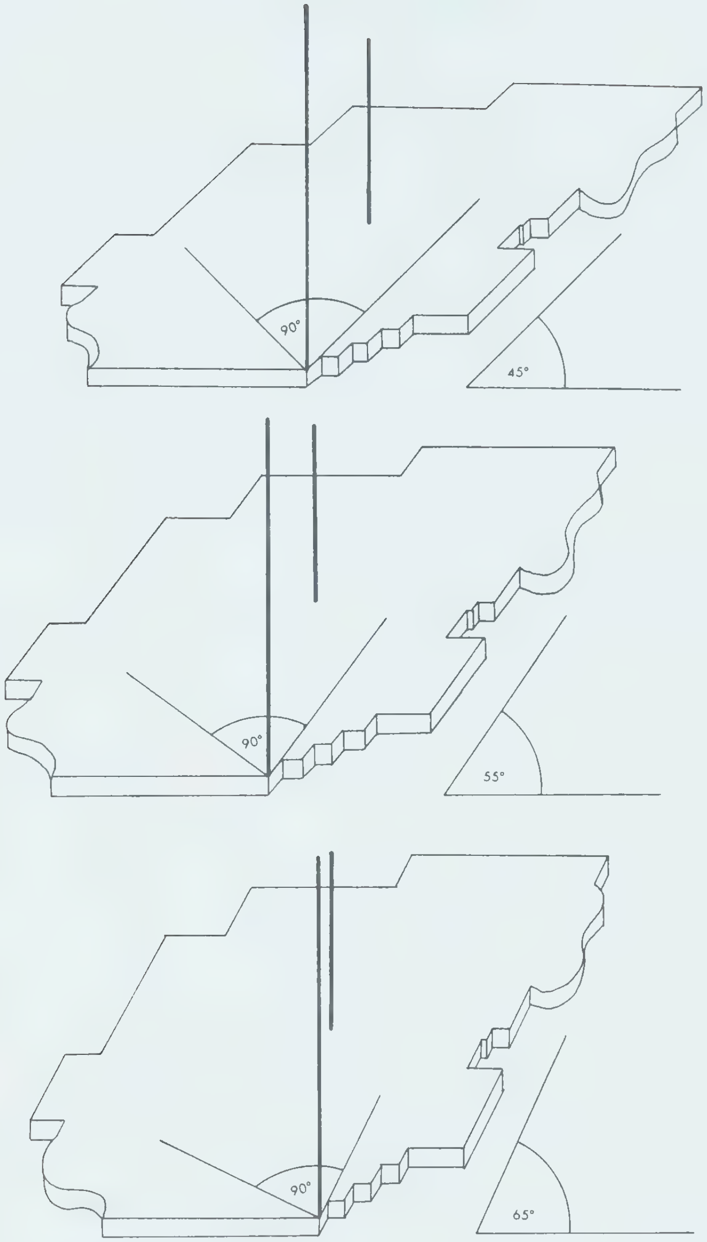
1. Jenks G. F. and P. V. Crawford, Viewing Point for Three-Dimensional Maps, Technical Report No. 3, University of Kansas, Lawrence, Kansas, 1967.



THREE ISOMETRIC BLOCKS
SHOWING VARIOUS ANGLES OF TILT FROM THE HORIZONTAL
AND THEIR EFFECT ON VERTICAL OBJECTS

FIGURE 2

The Base Map
Diagram 3

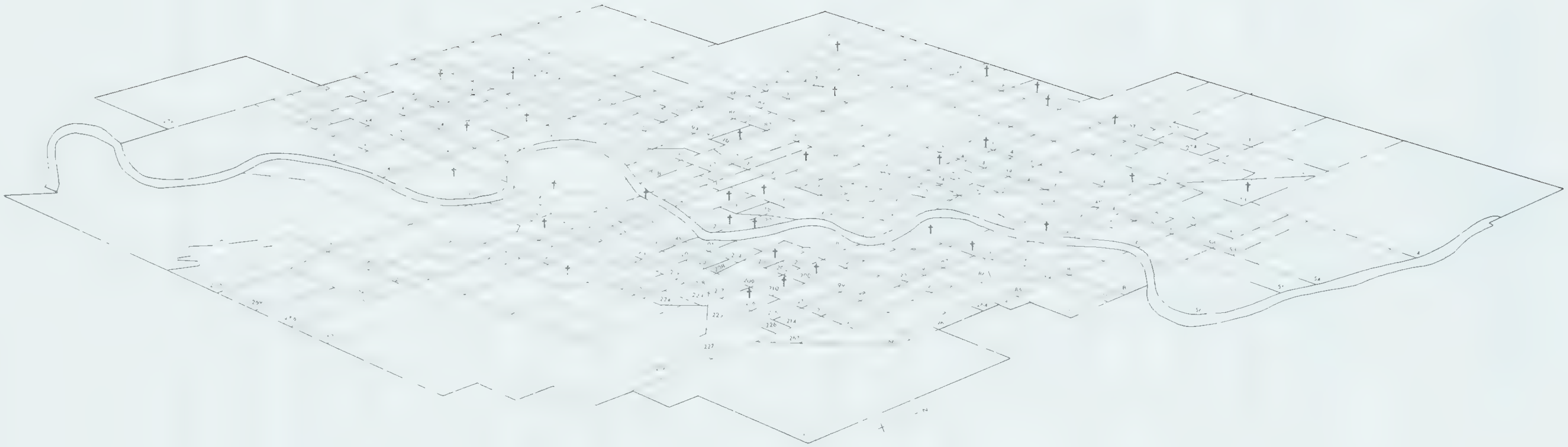
After having determined the angle of view and of tilt, a base map had to be drawn. A planimetric city map showing the cities polling divisions was used. This map had to be redrawn in the predetermined 118° view and 35° tilt. It was also drawn to a two point perspective. Here the scale diminishes proportionally in two directions towards the north and towards the west.

The original block was drawn to an approximate size of two and a half feet by one foot. This places the vanishing points approximately five feet apart. This size was needed to achieve a higher degree of accuracy. Polling divisions were the smallest unit used since the data was broken down into these units. The polling divisions are numbered and map 13 gives their street location. Once the map was drawn into a three-dimensional diagram it was used as the base for all other non-planimetric diagrams in this paper.

In addition to showing a set of political divisions, diagram 3 also contains one set of social statistics. All incidents of suicide in 1967 are shown. Each actual act of suicide occurs in a specific geographic location. Therefore it is possible, in most cases to be very precise in their actual occurrence. It is obvious that a statistic of this type is presented in such a way as to show the most precise location. The chosen symbol should, if possilbe, immediately convey the nature of the data. A simple black cross is used. One could just as easily have used other symbols such as an X or a dot.

However, a map is also to be pleasing. A black cross commands greater respect, in this case, than would a black dot or an X.

Incidents or suicide could just as well have been presented on a planimetric dot map. In a three-dimensional map we get the same information plus the additional advantages that are inherent to block diagrams. Note the symbols; the crosses stand at right angles to the surface giving them a very prominent and noticeable, if cemetary-like effect. (On a planimetric map they would be lying flat.) The point is that even a simple one-to-one ratio phenomenon can more meaningfully and realistically be shown on a three-dimensional map than on a planimetric one.



TWO POINT PERSPECTIVE MAP SHOWING THE CITY'S POLLING DIVISIONS
THE BLACK CROSSES INDICATE SUICIDES IN 1967

FIGURE 3

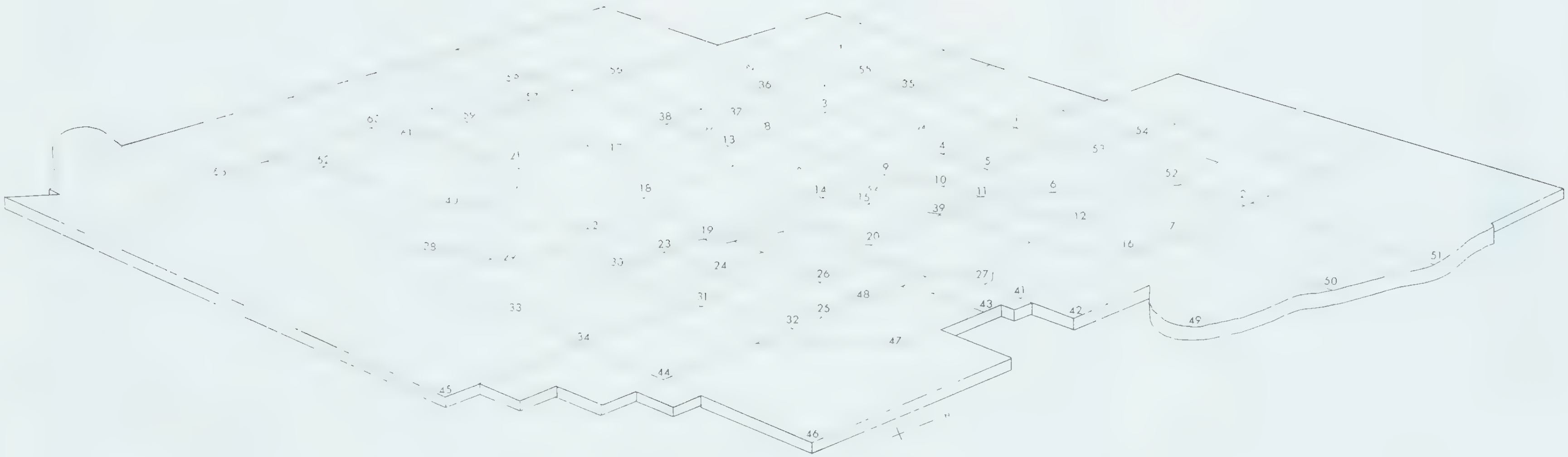
Two-Point Perspective Diagram Showing Census Tracts

Diagram 4

Diagram 4 uses the same base as diagram 3, however, here the area is divided into Census Tracts instead of Polling Divisions for the following reasons. In cartography one can always go from complex to simple by generalization, but not the reverse. In this case the 270 areas or Polling Divisions (1968) were reduced and generalized to the simpler 63 census tracts (1968).

The reasons for generalization and simplification were twofold. First census tracts are Federal Government approved and used delineations, and all the D.B.S. data gathered over the years (especially social, economic and demographic data) can more easily be correlated to the same area. Secondly, a diagram the size of diagrams 7, 8, 10 and 11 would be too complex to give a meaningful overview on an 8 1/2 x 11 sheet. Also a much greater proportion of diagram 7, 8 and 10 would be in shadow or be blocked.

Essentially diagram 4 shows 63 census tracts in three-dimensional form. Census tracts 1, 3, 4, 8, 9, 13, 14, 15, 35, 36, 53 and 55 are shaded; they represent those census tracts hidden from view on diagram 8 and are in the shadow of larger columns. The figures in small print indicate the crime rate per acre in each tract. With the exception of census tract 15 no significant high point is hidden.



TWO POINT PERSPECTIVE BLOCK DIAGRAM SHOWING CENSUS TRACTS
SHADED AREAS INDICATE HIDDEN CENSUS TRACT COLUMNS ON MAP 8

FIGURE 4

Block Diagrams with Isorythms
Diagram 5

Diagram 5 is an isarithmic block diagram showing total personal assault per square mile for the entire year of 1968. Total personal assault here means all crimes involving physical violence.

Table 1

Total Violent crimes known to Police in 1968

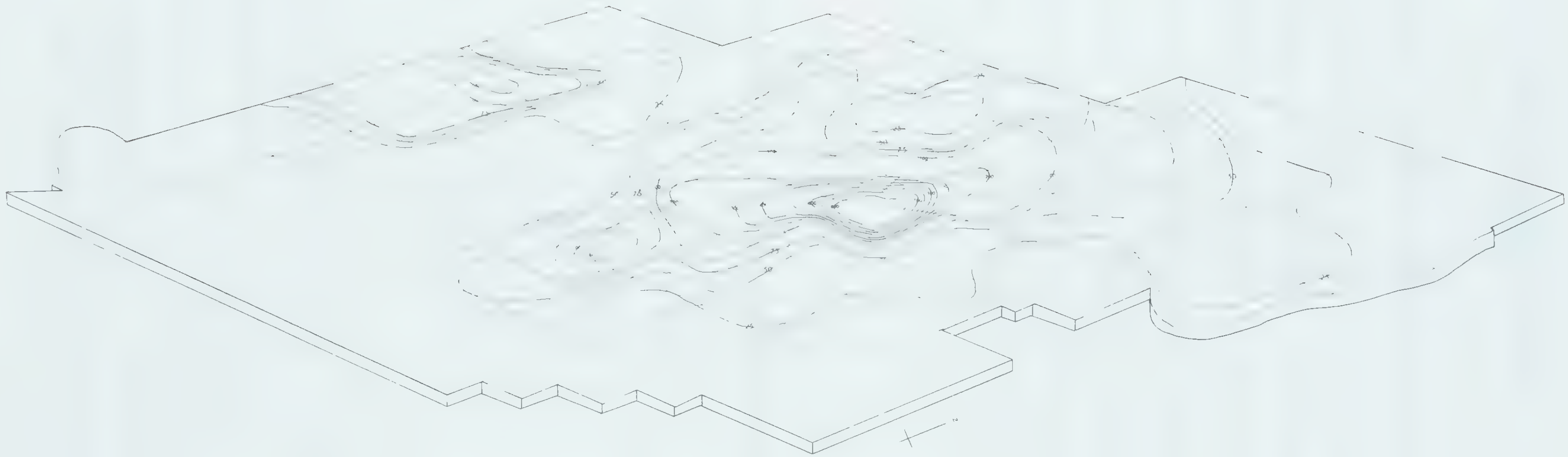
Police Description	Computer Designation	Number Known to Police
Murder, rape and wounding with intent	101	85
Robberies, armed and with violence	102	279
Purse snatching	104	10,384
Assaults	107	3,077
Indecent assaults and buggery	111	249

These crimes are of a nature that the exact location of each crime is hard to pinpoint. This rules out exact plotting and indicating every occurrence by a symbol which would supposedly be placed on the exact spot of the occurrence. One could show this data on a map of extent, such as a choropleth map. However, one would run into problems in large polling divisions like 14, 54, 56, 231, 176 around the perphery of the city. Where the area is large and the population is concentrated in a small segment of it. All of these

problems are overcome if the data are represented isarithmically. Isolines, in this case, are not as accurate as individual symbol locations but are more accurate than choropleth maps.

The data were available for each polling division, giving 278 high points on the map. These points were placed in the geographic center of each polling division which was totally made up of built-up area. In other polling divisions the high points were placed in the geographic center of the residential areas of that division. In this way the problem of the larger divisions was overcome where only small portions were residential.

Assaults per district ranged from a low of .05 to over 800 per square mile. Because of this range and the large area of low occurrence two distinct isoline intervals were used: from 0 - 100 an interval of 25 and from 100 - 800 intervals of 100. The isolines delimit areas fairly accurately; they are successful in giving a good and easy to read overview of the city for this indicator of human interaction. Since assault is a fluid occurrance, (the actual attack could take place over a large area; the victim could be pursued for blocks etc.) the wavy isolines further enhance the idea that the areas delimited are not hard and fast boundaries but fairly accurate indications of occurrences.



TWO POINT PERSPECTIVE ISARITHMIC BLOCK DIAGRAM
SHOWING TOTAL PERSONAL ASSAULT PER SQUARE MILE PER YEAR
TWO DISTINCT INTERVALS ARE USED FROM 0-100
(EVERY 25) AND FROM 100-800 (EVERY 100)

FIGURE 5

Block Diagrams and Choropleth
Diagram 6

The choropleth map is probably the most familar and most often used map to portray social statistics. It and the dot map have become major mapping tools of population scientists.

Diagram 6 shows the total crime rate per acre for 1968. Crime rate in this case means the total amount of crime known to the police occuring in that area in 1968. (Number of crimes per 1,000 population could also have been used effectively in the case.) The total crime rate per acre ranges from .05 to 13. This spread is divided into the following groups.

Table 2

Total Crime Rate per Acre per Census Tract

No. of Categories	No. of Census Tracts	Rate per Acre	Spread (approx.)
1	16	0.00 - 0.49	.5
2	22	0.50 - 0.99	.5
3	9	1.00 - 1.49	.5
4	10	1.50 - 2.49	1.0
5	3	2.50 - 4.49	2.0
6	2	4.50 - 8.49	4.0
7	1	8.50 +	

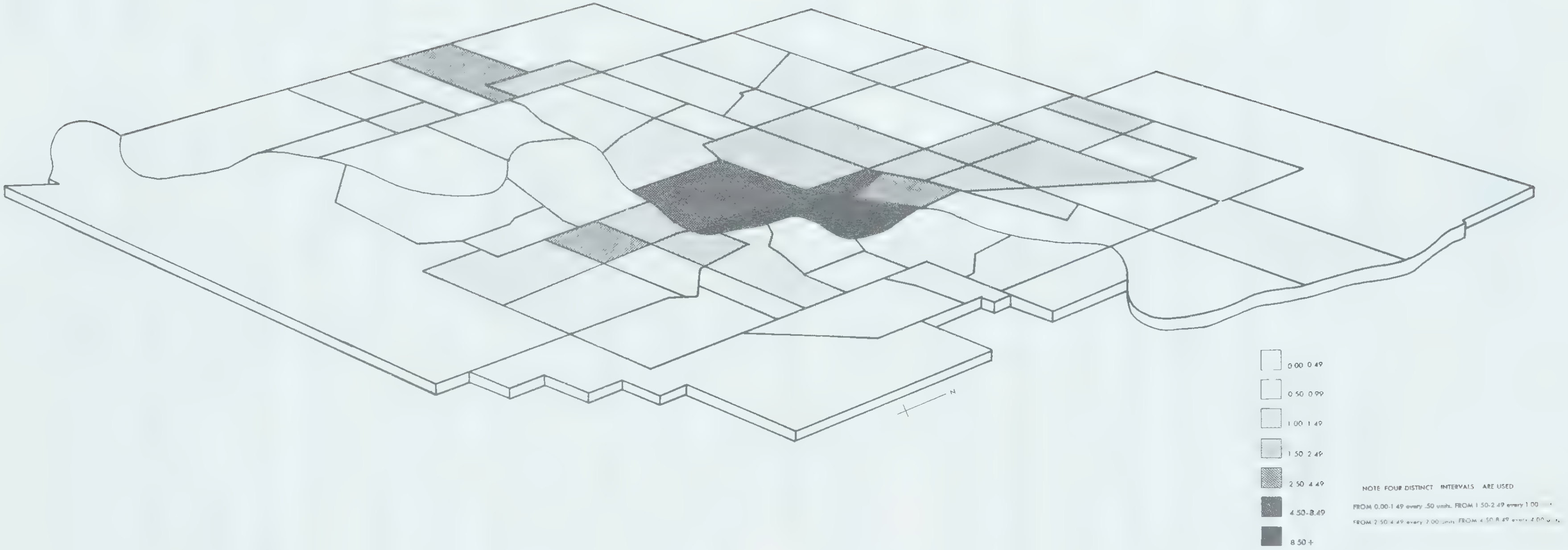
The selection of groups and the spread of values in each group is the most important aspect of a choropleth map. The greater the number of categories the greater the accuracy of the map since each category has a smaller margin of error. A choropleth map loses its value if too many categories are used since the human eye can

differentiate only a limited number of patterns. In diagram 6, seven categories were used, almost the maximum number of patterns the eye can readily differentiate. Herein lies the problem. A map is more effective if fewer categories are used: on the other hand it is much more accurate if it has a greater number of categories.

Here, the decision of the cartographer depends on the purpose or the impression he wants to create with his diagram, as well as the number of political divisions available, the range of his statistics and the intended audience of the finished diagram. Choropleth maps are not designed for extreme accuracy but rather for a quick comprehensive overview. In the case of diagram 6, we have 63 census tracts with a range from .05 to 13 crimes per acre. The range itself presents no difficulty; it could be 200 times as great. The difficulty arises, however, in its distribution. If this range, regardless of size, were distributed evenly, little difficulty would ensue as to the division into uniform categories. The 63 census tracts could then be divided into 5 categories of about 12 census tracts in each: this would represent a fairly accurate impression while at the same time being quite pleasing to the eye and easy to read. Unfortunately, this is not the case in diagram 6. (See table 2) Here 57 census tracts cover the range of .05 to 2.50. This is only one half the total range of statistics, yet it covers 90% of all the census tracts and close to 80% of the city's area. Only six census tracts make up the remaining range from 2.50 to 8.50+. It would be unrealistic to group these six with the previous 57 because of the great difference in values. These six tracts are extremely

significant in the overall impression the map is trying to convey. If we study categories 1, 2 and 3 we see that here we have what at first glance seems a very small division of only .5 per category. If we group these three categories into one, the spread would only be from .00 to 1.49. To do this, however, would involve grouping 47 census tracts into one category. This is highly unfair to the area, to say nothing of the erroneous impression the diagram would give since some areas would have three times the crime rate of others, yet all would appear the same. To group 70% of the tracts into one category where the incidence of crime range from .05 to 1.49 would be unrealistic; therefore four distinct intervals were necessary.

Seven categories were used to make the map more readable as well as accurate. To help differentiate the categories, the lowest one was made up of a very sparse dot pattern so that it could very readily be separated from the next pattern. The highest category can easily be separated from the preceding one since it is not a dot pattern but a solid black. This leaves us with only five patterns where a more scrutinizing look is needed. Patterns for these five intermediary categories were chosen with as much light differentiation among them as possible. These patterns were placed in such a way that in each category regardless of position on the map, the dots were kept parallel. Only dot patterns were used, instead of several varying patterns such as lines, stars, etc., to give the map a more continuous effect from very light to extreme black. In this way the reader gains a better impression of a smoother continuum from light to dark or from low to high values.



TWO POINT PERSPECTIVE CHOROPLETH BLOCK DIAGRAM
SHOWING CRIME RATE PER ACRE PER YEAR FOR 1968

FIGURE 6

The Statistical Surface
Diagram 7

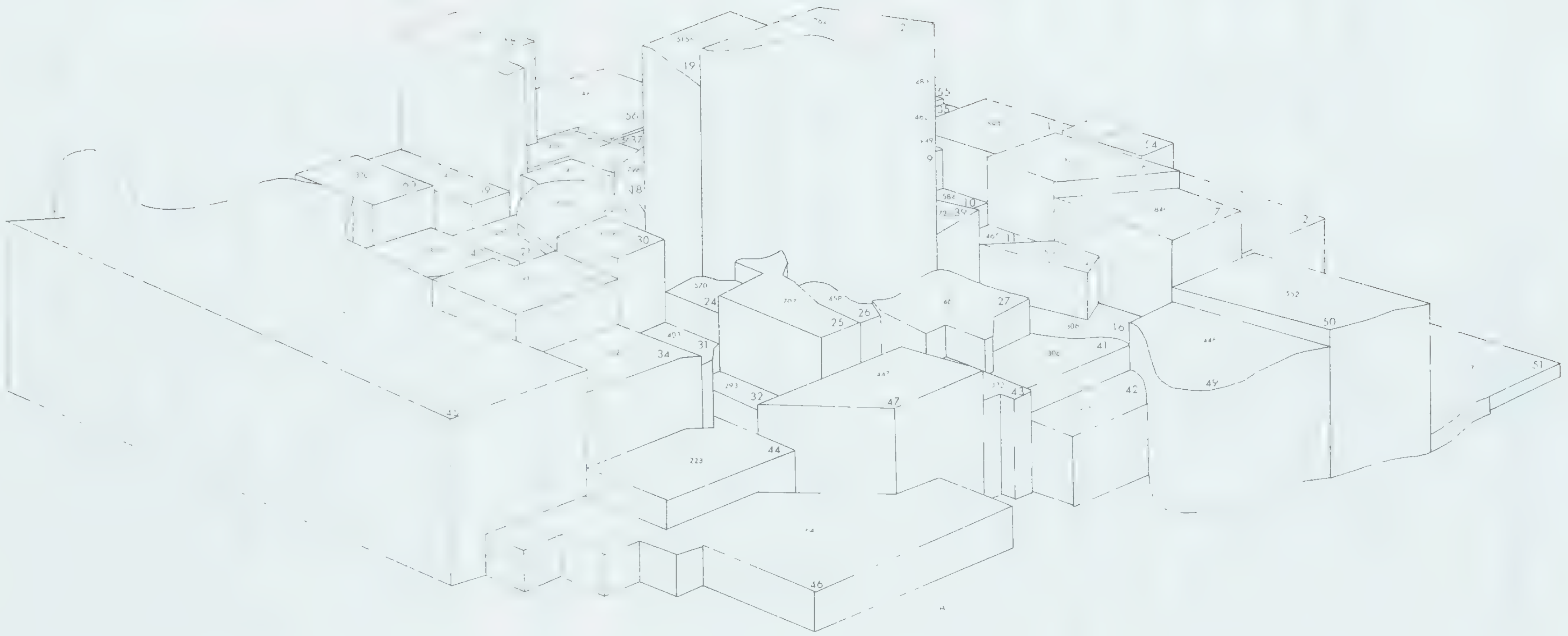
Diagram 7 is a two-point perspective block diagram showing incidents of crime by census tracts in a stepped statistical manner. In each census tract the total number of crimes reported to police were tabulated and then each census tract was raised vertically above the datum plane of the block in direct proportion to the actual number of occurrences. For example, census tract 44 had a total of 223 reported crimes for 1968 and census tract 45 and 711 reported crimes. These two blocks were then raised in height according to these values to a predetermined vertical scale.

The problem of acquiring a proper scale can be appreciated when the lowest and the highest values for the census tracts are studied. The lowest value was census tract 51 with a total count of 117; the highest census tract was 20 with a total count of 7,622. If a simple scale were used, as with a direct arithmetic ratio, we would run out of vertical space very quickly. Assuming that census tract 51's value of 117 crimes is represented by 1/4 inch in vertical height, then census tract 20 would require over 19 inches of height and would completely unbalance the entire diagram. If, on the other hand, we reduce the scale so that 117 crimes are represented by a large fraction (1/8, 1/10, 1/32), we would have almost no differentiation among the blocks of lower value. The solution then was to construct a logarithmic scale where the lower values have a large differentiation in height but the higher the values go the smaller the height difference becomes.

All the techniques and values used on this diagram are correct, yet it differs greatly in appearance from diagram 8. Although diagram 7 carries the correct data it is grossly misleading and gives and erroneous impression. There are two major reasons for this - one being that this is not an ordinary planimetric map but a perspective block diagram, the second is that the columns are drawn three-dimensionally. If we study census tracts 44 and 45 we see that the height of each column is proportional (according to the logarithmic scale used) to the number of crimes for that area. Even though this is true, the map reader cannot ignore or suppress the visual impact of the volume of a column, since volume increases cubically whereas height is increased in this case, logarithmically. Census tract 45 appears to indicate a very large block of crime whereas 44 a much smaller amount; however, just the opposite is true (see diagram 8).

Not only is the visual effect of the column's volume ignored but the area of the census tract has also been ignored. Census tract 45 has almost six times the area of 44 yet its total known crime rate is not six times as great as census tract 44. The incidence of robbery in census tract 44 is three times as great as in census tract 45, although diagram 7 gives the impression that census tract 45 is a very dangerous area to live in; in fact the opposite is true.

A block diagram or a three-dimensional map, because of its three-dimensional volumetric aspects, can convey the wrong impression much easier than a planimetric map. The cartographer has to be more aware of equal rates since nonequal distribution errors are magnified cubically.



TWO POINT PERSPECTIVE BLOCK DIAGRAM
SHOWING TOTAL ABSOLUTE INCIDENTS OF CRIME PER CENSUS TRACT
IN A STEPPED STATISTICAL MANNER

FIGURE 7

Corrected Stepped Statistical Surface
Diagram 8

Diagram 8 is a two point perspective block diagram showing crime rate per acre per census tract for 1968. Each census tract portrayed on this map has a crime rate value. This value was calculated by relating total area in acres to the 1968 total crime occurrence know to the police. The land area in acres was secured from City of Edmonton land use maps - these remain constant. The total crime values were generalized from the various polling divisions that make up one census tract (the reason for this generalization has already been explained).

If we compare diagrams 7 and 8, all the faults of misrepresentation and misconceptions on diagram 7 become evident. Instead of using only total crimes, the volume of the columns is directly proportional to the known crime for each census tract area.

The construction of diagram 8 presents several technical problems.

1. The North Saskatchewan River on diagram 7 is represented by the only curved line on the diagram; in diagram 8 the river was squared off to straight lines. Since the river has no statistical value, it would always remain at the datum plane making it invisible. The squaring of the lines representing the river not only makes it easier to draft but also gives it a

more aesthetically pleasing effect as well as more continuity in a drawing consisting of nothing but straight lines.

2. This is a two-point perspective block diagram; therefore all lines must converge on one of the two vanishing points on the artifical horizon. On the datum plane all lines conform to this rule. As a column rises in height, the top surface represents the area of the census tract at the datum plane. The higher the column, the smaller the area on top of the column since the sides and ends of this surface would also have to be drawn to converge at the two vanishing points. This is not the case in diagram 8 where the top surfaces of the column have been kept the exact size of the census tract at the datum plane. The reason for this is that the difference in shape and size is so small that unless it is very accurately measured, it is indiscernible. Since the impression and hence the value of the diagram is unchanged and the drafting involved rather complex, it was felt that this exception to the converging rule was justified.

3. The choice of the viewing angel. Edmonton has its high crime area in its geographic center. No matter from which angle one views the city, the tall columns at the center will block out some lower columns surrounding the center. There are three possible solutions to this problem:

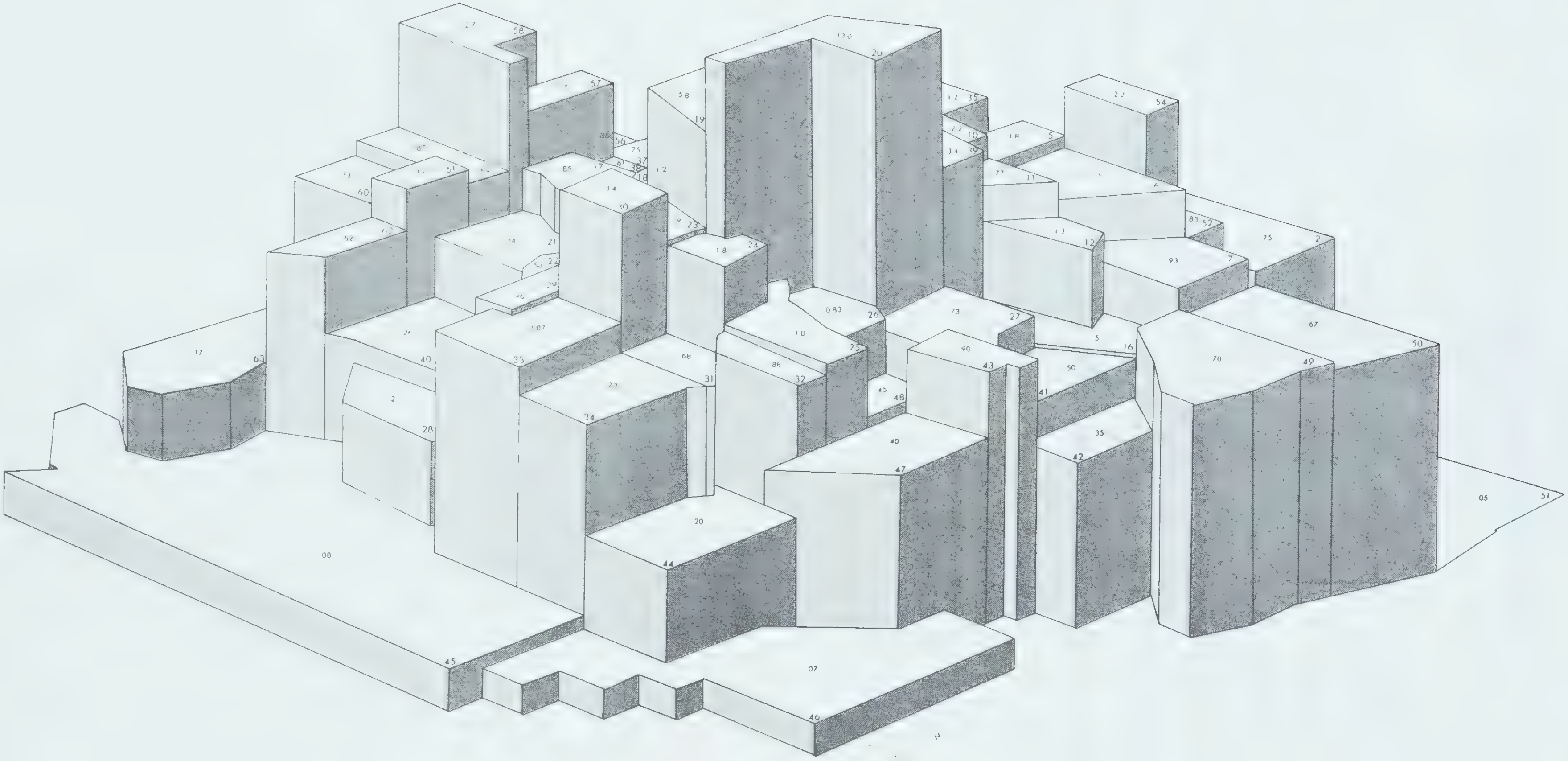
a. The tall central columns could be made transparent so that the hidden columns or at least the top surface of these columns could be seen. This would solve the problem thus exposing the entire surface of the city. However, since a transparent column would have to be broken in its solidity to allow another column with its top surface to show through, all advantage is lost. We would have so many lines, both vertical and horizontal, that the confusion caused would destroy the three-dimensional solidity of the columns.

b. One could separate the city into approximate halves using the North Sasakchewan River as the dividing line. The two maps would then be viewed from two different and opposite angles. The northern half of the city to be viewed from the south, and the southern half from the north. The disadvantages of this solution are obvious. Not only is the city divided, thereby denying a complete overview, but the sections are also viewed from opposite directions. One would have to metally flip one viewpoint around and imagine the two sections together; this nullifies one of the basic purposes of a block diagram, namely the clear, easy and simple protrayal of statistics in a three-dimensional form.

c. The third solution, and the one chosen in this work is to first select a view that will obstruct the least area and then show the hidden areas and values on a separate diagram.

The viewing angle of 298° east of north was chosen since this angle presents the lower columns of south and east areas in front of the tall center columns. Directly behind the tallest two columns we have the municipal airport and a low population density area; therefore, the hidden areas are some of the more insignificant census tracts in relation to the rest of the city, especially as far as an overview is concerned. The notable exception is census tract 15 both a high density and high crime area (5.4 per acre. See diagram 4 for the hidden areas and values). The range of this diagram is from .05 to 13.0. This also necessitates a logarithmic vertical scale as used in diagram 7.

The columns were shaded to give the block diagram a greater and better three-dimensional and aesthetic effect. The usual shading convention, of light coming from the top right hand corner of the page was used. The darker sides was screend 40% and light side 10%. Three copies were made, one containing the outline of the diagrams, two and three containing the shading for each side. These three sheets were registered and separatly photographed, then combined for a final diagram.

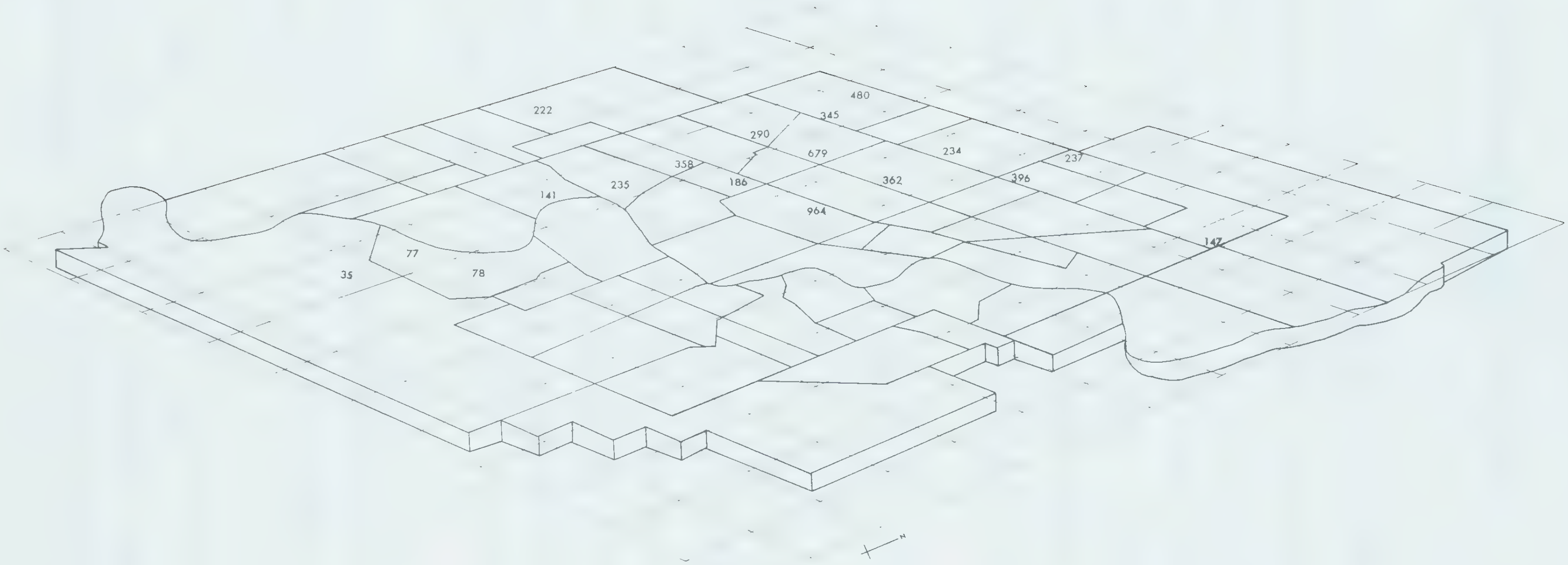


TWO POINT PERSPECTIVE BLOCK DIAGRAM SHOWING
CRIME RATE PER ACRE PER CENSUS TRACT FOR THE YEAR 1968

FIGURE 8

Block Diagrams with Superimposed Grid
Diagram 9

Diagram 9 is a two point perspective block diagram with census tracts showing a superimposed one square mile grid. The purpose of diagram 9 is two-fold. First, it is used to show the values of the hidden census tracts from diagram 8, and secondly, it shows the positional and directional relationships of the grid and the census tracts. This is done so that the locations of any column from diagram 10 can be determined.



TWO POINT PERSPECTIVE BLOCK DIAGRAM WITH CENSUS TRACTS
SHOWING SUPERIMPOSED ONE SQUARE MILE GRID
SHADED AREAS ARE THOSE NOT SEEN ON MAP 10 DUE TO SHADOW OF TALLER COLUMNS

FIGURE 9

Equal Area Stepped Statistical Surface
Diagram 10

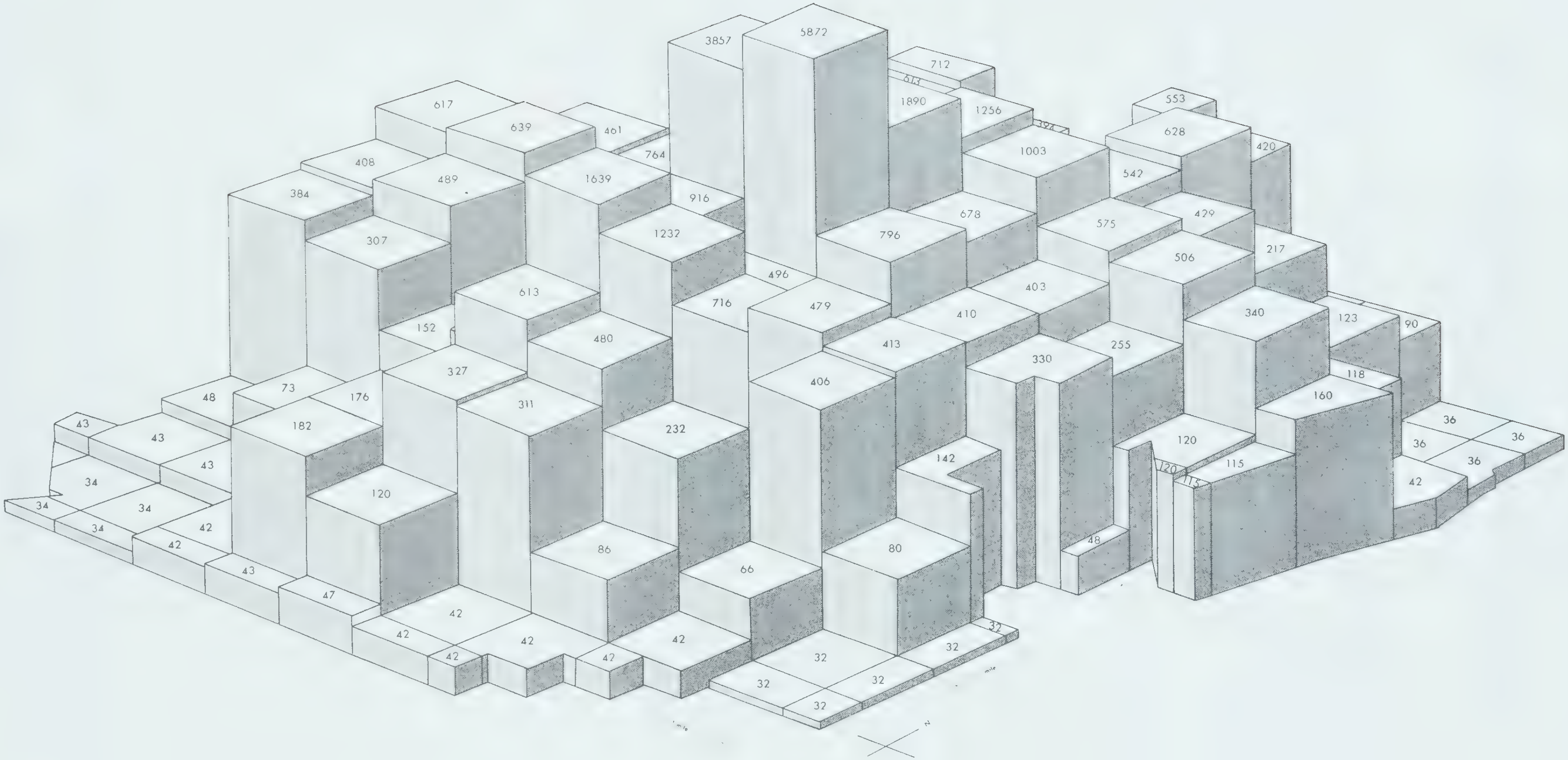
This is a two point perspective block diagram showing total known crime by unit area, the square mile. When we compare diagram 10 and diagram 7, we see that both diagrams use the same statistics, the total crimes known to the police per area. The diagrams differ, however, in that on diagram 7 the area was a variable, (the areas of the census tracts were of different value) whereas in diagram 10 the area is kept constant thereby making the column on diagram 10 a true rate.

A one square mile grid was used to get a more realistic distribution of crime. Although diagram 8 shows the crime rate per acre, this is still within the larger area of the individual census tract. In two large adjoining census tracts, an area of heavy occurrence could overlap the boundaries of these tracts, taking up perhaps 10% of the area of each. The remaining areas could have a very light or low occurrence; yet the total value would be distributed throughout all the census tracts thereby giving a wrong impression of the whole area.

All the advantages and disadvantages discussed in relation to diagram 8 also apply here. Diagram 9 shows the hidden areas and values for diagram 10.

The scale used is also logarithmic and the same procedure for shading was used as with diagram 8. Each column is one square mile in area with the exception of the periphery of the city where

the city boundary cuts off certain squares. These partial squares were, however, calculated for area and their values in relation to the occurrences was adjusted to maintain the same common rate as the full squares.



TWO POINT PERSPECTIVE BLOCK DIAGRAM SHOWING
TOTAL CRIME PER UNIT AREA, THE SQUARE MILE

FIGURE 10

Block Diagrams and the Value of Generalization
Diagram 11

Diagram 11 is a block diagram showing occurrences of hit and run on Edmonton's major thoroughfares. This highly generalized map originated from 1500 bits of information which was then plotted on a planimetric map (dot map).

The major streets which had the highest occurrences were plotted on the datum plane of the block diagram. These were then divided into one mile segements, the segments were then drawn as blocks with each block representing five incidents per mile for 1968. It is quite obvious that a great deal of generalization had to take place to reduce 1500 incidents to this pictorial form. It would be very difficult to see any definite pattern if all 1500 incidents were plotted. Alsleben[1] states that the eye can receive three million bits of information per second but the brain can handle only sixteen per second.

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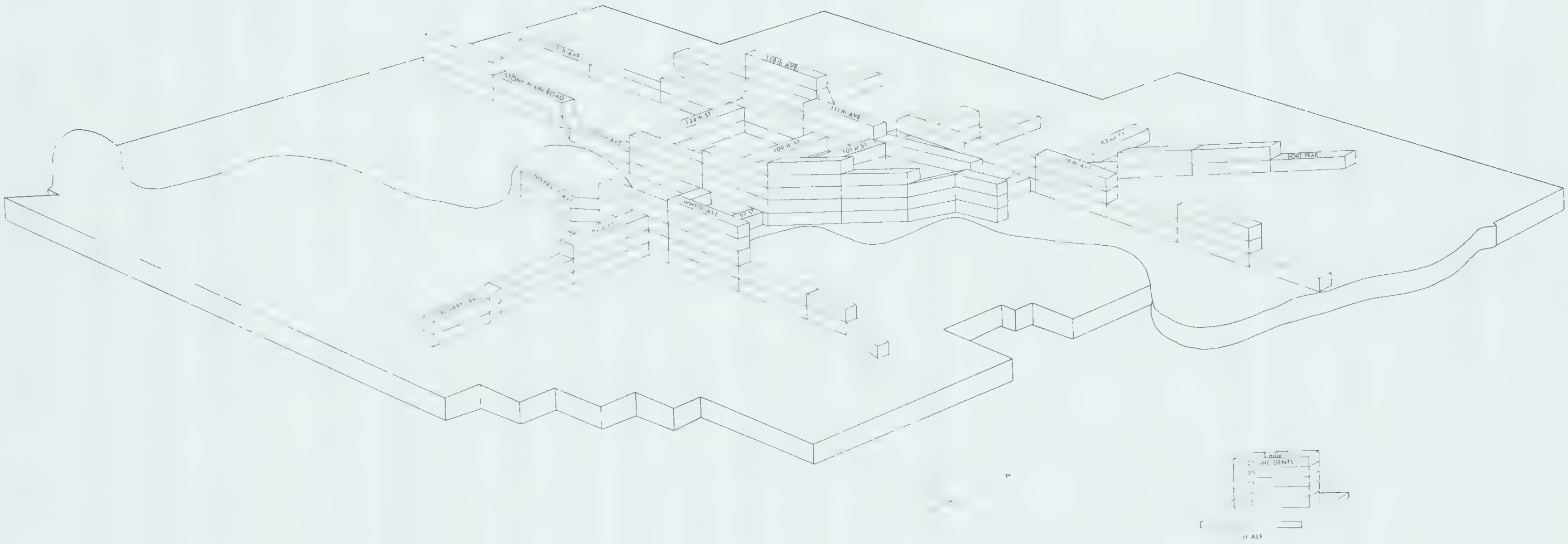
[1] Alsleben, K., Aesthetische Redundanz, Hamburg, 1962.



INCIDENTS OF HIT AND RUN ON EDMONTON'S MAJOR THOROUGHFARES
1968 EDMONTON HIT AND RUN OFFENSES CALCULATED PER MILE
STATISTICS FROM 1968; EDMONTON'S POLICE DEPARTMENT'S TRAFFIC DIVISION

FIGURE 11

CHAPTER V

THE ADVANTAGES OF THE BLOCK DIAGRAM

The map is still the most indispensible tool of any geographer, especially in the study of areal distributional phenomena. The use of any additional cartographic technique is therefore of benefit to him.

Problems of Urban Mapping

More and more populations are becoming increasingly urban. This obviously brings with it change and problems. When mapping an urban area the cartographer has to contend with a great volume of statistics for a rather small physical area. The question of scale and generalization becomes immediate. A great number of statistics of every nature are collected by many agencies annually. To make use of even a small percentage of these data they have to be presented in other than just tabular form; here specialized thematic mapping is of great value.

In evaluating the efficacy of the three-dimensional block technique with the statistics used we will compare them to the five points outlined in Chapter II.

1. Is interest and attention created? In comparison to planimetric maps the three-dimensional block because of its third dimension creates as immediate interest since the mind is familiar with solid shapes.

Diagrams 7, 8, 10 and 11 arouse an immediate curiousity as to the meaning of the vertical columns.

2. Are visual relationships easier to understand? To compare sixty-three areas of different values and be able to understand the relationship of each with another is almost impossible if they are presented in tabular form on a planimetric map. Even the choropleth map, although quite good in this respect falls short of the block diagram, where the vertical development makes the inter-relationships of the areas immediately visually apparent. (See diagrams 6 and 8).

3. Does this technique save time? The perspective block diagram is much more cartographically complex and requires more time in its conception, design, tabulation and its physical production. However, recent computer techniques have been developed that now make the three-dimensional diagram very feasible as far as time is concerned. (See Peucher, Computer Cartography)[1]

   The 3-D diagram communicates a large volume of information almost instantaneously. In diagram 11 1,500 cases of Hit-and-Run were tabulated and reproduced in block form, showing those areas of greatest incidence. At a glance the reader gets a composite picture

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1. Peucker, T. K., <u>Computer Cartography</u>, Resource Paper No. 17, Association of American Geographers, Washington, D.C., 1972.

of the situation. Since communication is the essence of maps this method certainly saves time. Admittedly this speedy communication is gained at the expence of precision. However, precision is relative depending on its particular use.

4. Does this method give a better comprehensive picture or overview?

   Compared to tabular forms or a planimetric map 58,000 crimes would cause problems in respect to a comprehensive picture and an understanding of the total scene. In a three-dimensional diagram, even though generalized, the visual impression of the third dimension adds significantly to the clarity and understanding of the total picture. (See diagrams 8, 10 and 11).

5. Does this technique stimulate analytical thinking?

   Since the three-dimensional perspective block is more easily and rapidly understood, for all of the above reasons, than other maps carrying the same information, they tend to stimulate and help in further study. The amount of information and value one can derive from a map depends on the knowledge of the individual map reader.

Unfortunately, it is the case in most cities that urban planners have little or no maps of the social character of the city's population. Although most have all types of social statistics

available, planners either cannot or do not have time to interpret them. A greater use of specialized thematic mapping could help to alleviate these problems in the future.

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APPENDIX

City Reference Maps

Maps 12, 13 and 14 were included for positional and locational reference for the census tracts, polling divisions, neighbourhoods and for general orientation.

Maps 12 and 14 were made by the Popualtion Laboratory of the Sociology Department of the University of Alberta, map 13 by the City of Edmonton.

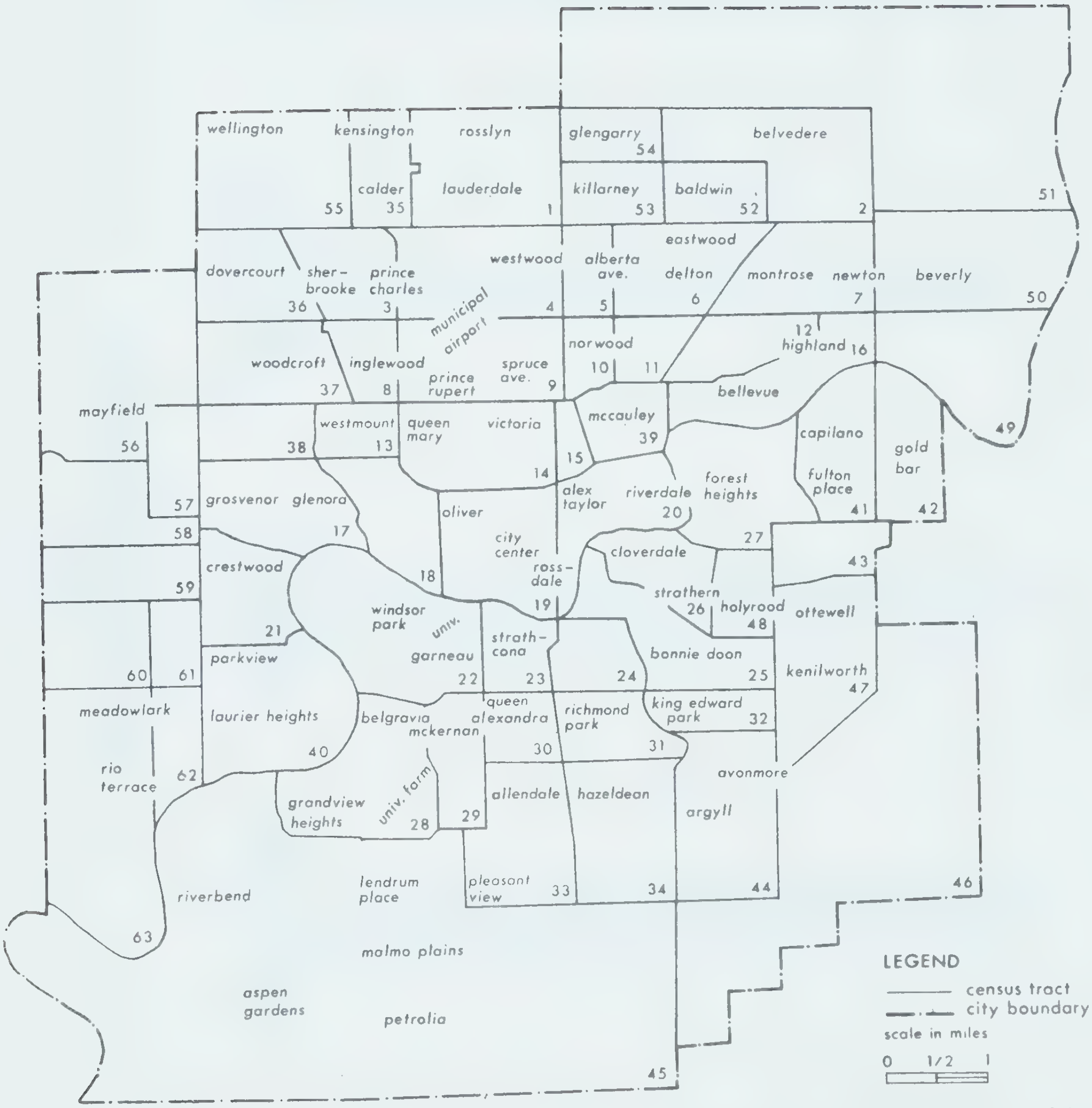
BASE MAP PREPARED BY POPULATION
RESEARCH LABORATORY UNIVERSITY OF ALBERTA UNIVERSITY

EDMONTON CENSUS TRACTS
STREET DESIGNATIONS

FIGURE 12

EDMONTON POLLING DIVISIONS

FIGURE 13



BASE MAP PREPARED BY POPULATION RESEARCH LABORATORY UNIVERSITY OF ALBERTA UNIVERSITY

EDMONTON NEIGHBOURHOOD AREAS

FIGURE 14

Table 3

Total Crimes and their Rates for Census Tracts 1968

Census Tract	Total Crimes known to Police 1968	Rate per Unit Area, the Acre	No. of Violent Crimes as in Diagram 5	Rate per Acre
1	593	.71	49	.058
2	513	.75	51	.074
3	600	1.10	64	.115
4	306	2.40	21	.016
5	476	1.77	78	.288
6	1,031	1.50	87	.117
7	804	.93	79	.087
8	378	1.20	26	.080
9	949	1.70	51	.093
10	584	2.20	66	.251
11	465	1.80	64	.242
12	519	1.30	40	.100
13	277	.86	14	.043
14	1,327	1.60	99	.118
15	789	5.40	75	.513
16	306	.50	29	.044
17	415	.85	26	.053
18	796	1.20	76	.117
19	5,156	5.80	379	.425
20	7,622	13.00	803	1.372
21	262	.54	8	.016

Table 3

(Continued)

Census Tract	Total Crimes known to Police 1968	Rate per Unit Area, the Acre	No. of Violent Crimes as in Diagram 5	Rate per Acre
22	619	.50	31	.025
23	727	1.90	57	.147
24	570	1.80	60	.192
25	707	1.00	29	.041
26	458	.83	48	.087
27	461	.73	35	.055
28	199	.21	7	.007
29	365	.96	31	.081
30	1,056	3.40	76	.247
31	403	.68	39	.065
32	293	.88	22	.066
33	913	1.07	61	.072
34	522	.70	24	.031
35	463	1.20	40	.099
36	476	.82	16	.027
37	450	.75	13	.021
38	238	.61	13	.033
39	720	3.40	109	.509
40	318	.26	20	.037
41	306	.50	13	.021

Table 3

(Continued)

Census Tract	Total Crimes known to Police 1968	Rate per Unit Area, the Acre	No. of Violent Crimes as in Diagram 5	Rate per Acre
42	216	.35	22	.021
43	322	.90	15	.042
44	223	.20	15	.013
45	711	.08	23	.002
46	164	.07	11	.004
47	447	.40	25	.024
48	203	.45	22	.049
49	446	.70	38	.059
50	552	.67	44	.053
51	117	.05	4	.001
52	267	.83	34	.106
53	335	1.10	27	.084
54	703	2.20	44	.137
55	408	.43	51	.046
56	445	.36	22	.017
57	429	1.60	51	.188
58	1,357	2.70	124	.242
59	349	.87	46	.115
60	370	.73	17	.115
61	239	1.00	35	.145
62	177	.62	6	.021
63	216	.17	12	.009

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